

Adept Viper s650/s850 Hardstop Installation Guide



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Joint 1 Adjustable Hardstops Installation

1

1.1 Installing Adjustable Hardstops

Adept provides the required information in this guide to let you create adjustable hardstops for Joints 1, 2 and 3 on Adept Viper s650/s850 robots. These adjustable hardstops are user-manufactured and installed options that can be used to limit the work envelope of the robot.

1.2 Joint 1 Adjustable Hardstops

When shipped from the factory, the mechanical ends (hardstops) are set on the robot so that the stroke of the first axis (Joint 1) is ± 170 degrees. You can change the mechanical ends of the Joint 1 axis by adding hardstops. **Figure 1-1** shows the positions of the added hardstops.

To change the hardstops, four types of user-supplied mechanical stop parts are required: hardstops (2), Fixture block A (2), Fixture block B (1), and plates (2). The figures on the pages that follow show the reference drawings of these parts. Referring to those drawings, make the hardstop parts as necessary so that you can set your desired motion space.

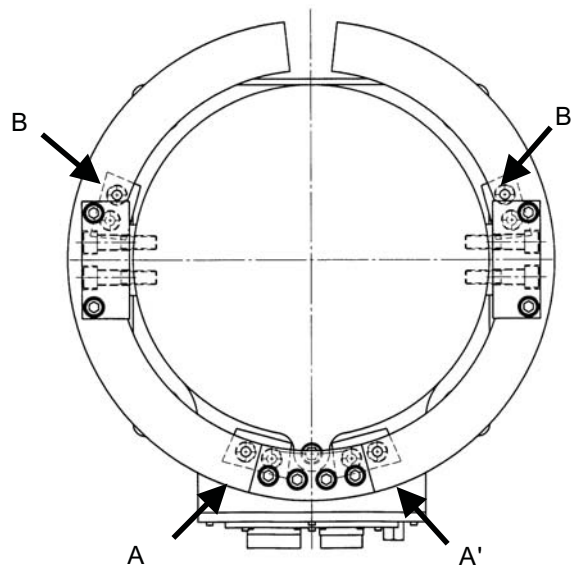


Figure 1-1. Added Hardstop Locations

Table 1-1 shows the angles of the Joint 1 axis in the positive and negative directions when it is in contact with each hardstop.

Table 1-1. Stroke of Joint 1 Axis to Added Hardstops

Added Hardstop Position	Positive Direction	Negative Direction
A	5°	28° 45'
A'	-28° 45'	-5°
B	95°	118° 45'
B'	-118° 45'	-95°
Permanent mechanical ends	170°	-170°

To add adjustable hardstops to Joint 1, perform the following steps:

- Make the hardstop parts. See **“Making the Hardstop Parts”** (see below).
- Install the hardstop parts on the two sets of threaded holes on the outside of the Adept Viper s650 or s850 robot (the parts and steps for installing the hardstops on Joint 1 are the same for both robots). See **“Joint 1 Installation Procedure” on page 11**.
- Modify the joint limit softstop locations for Joint 1 using the SPEC program. See **“Modifying Joint Limit Softstop Locations for Joint 1” on page 14**.

Making the Hardstop Parts

Use the drawings below to make the following hardstop parts.

- Hardstops, quantity 2 (see **Figure 1-2**)
- Fixture block A, quantity 2 (see **Figure 1-3**)
- Fixture block B, quantity 1 (see **Figure 1-4**)
- Plate, quantity 2 (see **Figure 1-5**)

Use 1018 CR steel for the parts. Unless otherwise specified, corners should be C0.1 to C0.5.

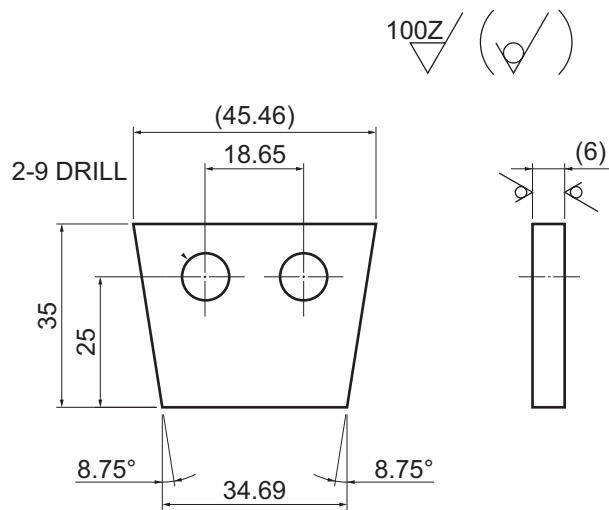


Figure 1-2. Hardstop

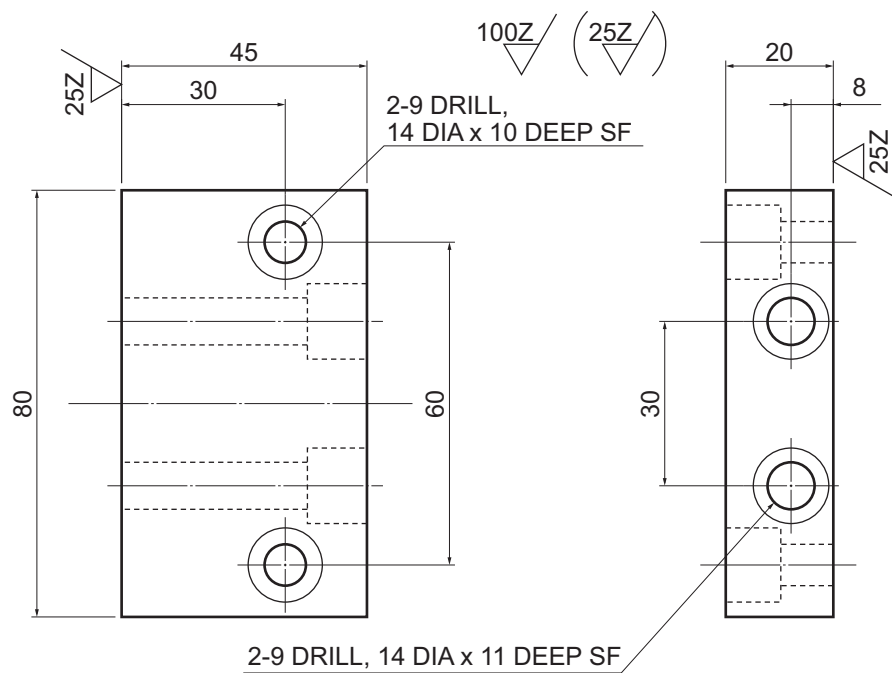


Figure 1-3. Fixture Block A

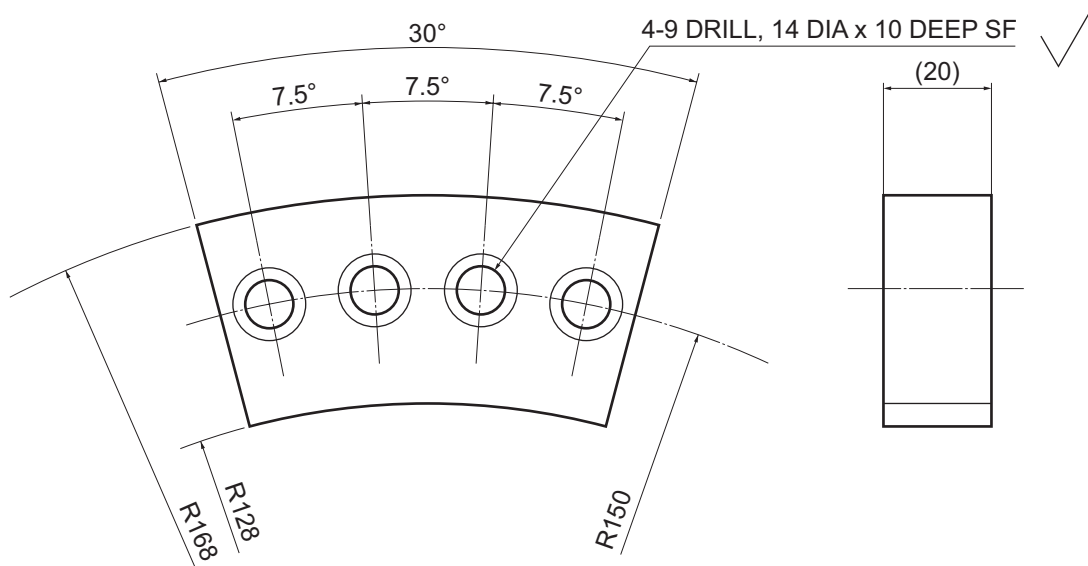


Figure 1-4. Fixture Block B

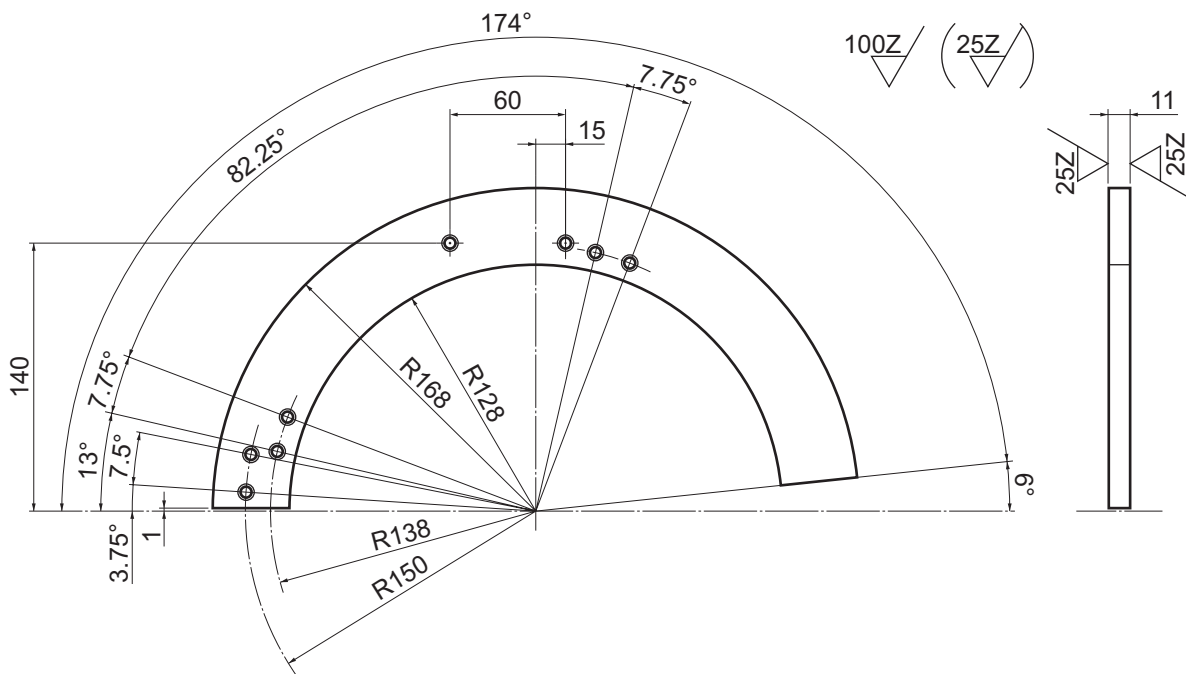


Figure 1-5. Plate

Joint 1 Installation Procedure

1. Move the Joint 1 axis until the stopper bolt is positioned on the inside of the motion space that you want to set. See [Figure 1-6](#).

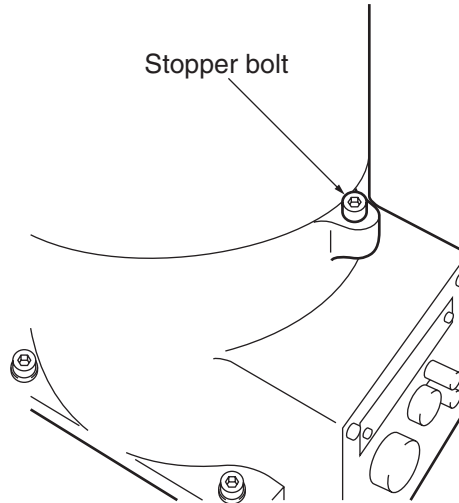


Figure 1-6. Stopper Bolt on Robot

2. Secure Fixture block A to one of the two plates with two M8 x 16 hex, socket-head bolts. Tighten to a torque of 36 ± 7.2 Nm. Repeat this step for the other plate and Fixture block A assembly. See [Figure 1-7](#).

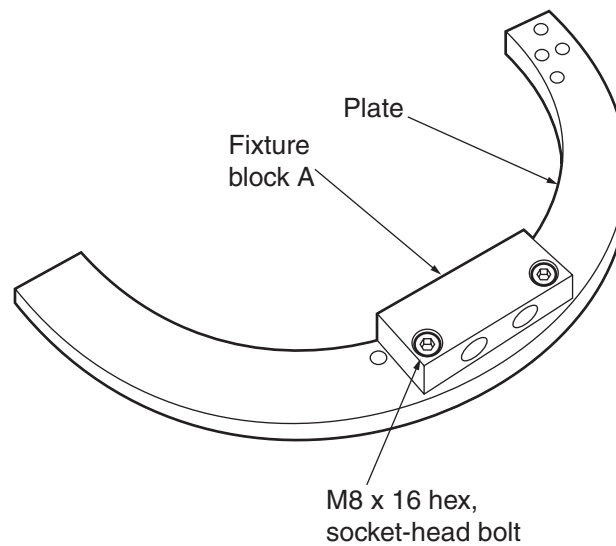


Figure 1-7. Fixture Block A Attached to Plate

3. Each robot can have a maximum of two hard stops. One is for the positive direction and the other is for the negative direction. There are four possible positions for these hard stops (two per plate; see [Figure 1-1 on page 7](#) for available hardstop locations). Install the hardstops on the side of the plate(s) opposite to Fixture block A (installed in step 2). Secure the two hardstops to each assembly with two M8 x 16 hex, socket-head bolts. Tighten to a torque of 36 ± 7.2 Nm. See [Figure 1-8](#).

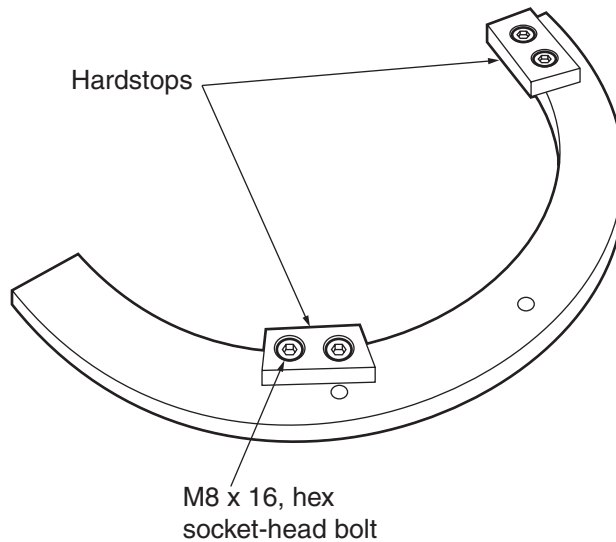


Figure 1-8. Hardstops Secured to Plate

4. Temporarily secure one of the assemblies made in the above two steps to one of the sets of threaded holes on the sides of the robot. Use two hex, socket-head bolts. Orient the assembly as shown in [Figure 1-9](#).

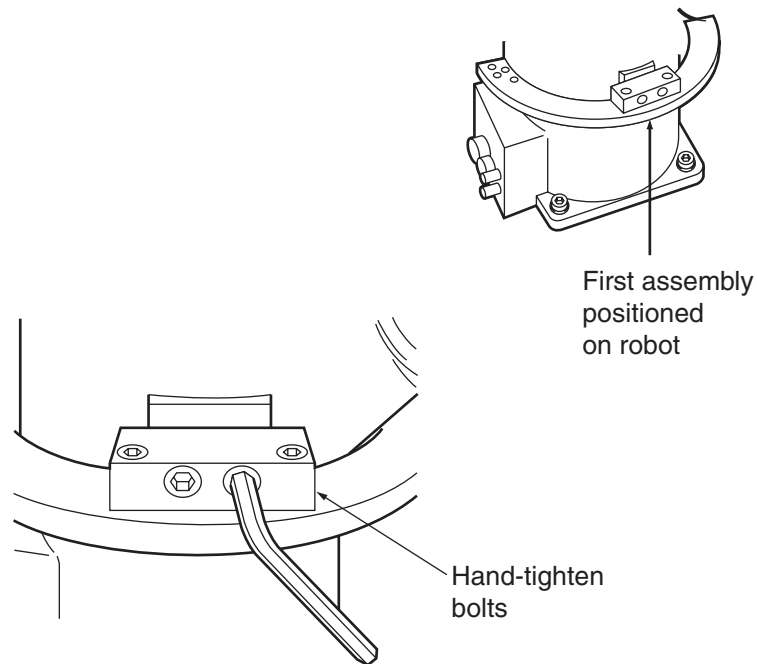


Figure 1-9. Assembly 1 Positioned on Joint 1

5. Temporarily secure the other assembly to the opposite side of Joint 1. See [Figure 1-10](#).

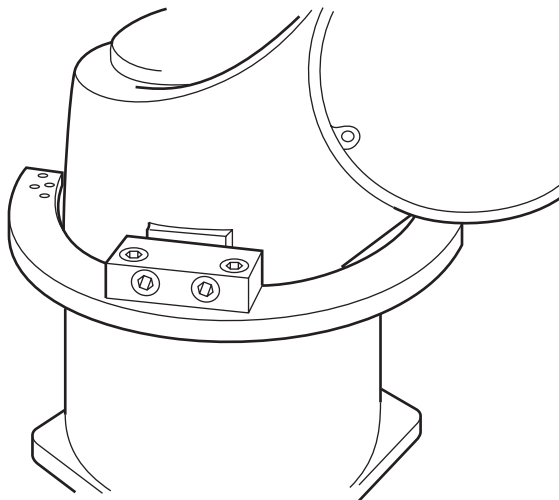


Figure 1-10. Assembly 2 Positioned on Joint 1

6. Attach Fixture block B to assemblies 1 and 2 to join them together. Use M8 x 16 hex, socket-head bolts. Tighten to a torque of 36 ± 7.2 Nm. See [Figure 1-11](#).

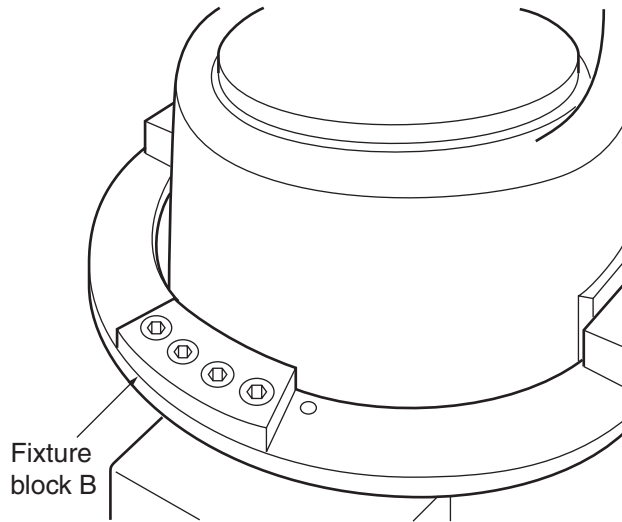


Figure 1-11. Fixture Block B Joining Assemblies 1 and 2

7. Secure assemblies 1 and 2 to the robot by firmly tightening the hex, socket-head bolts. Tighten to a torque of 36 ± 7.2 Nm.

Modifying Joint Limit Softstop Locations for Joint 1

After installing the adjustable hardstops, you must modify the softstop locations using the SPEC program. See the [Instructions for Adept Utility Programs](#) for more details on the SPEC program.

NOTE: After adding hardstops, set the software motion limits 5 degrees inside from the added hardstops. If the softstops are set to a value less than 5 degrees inside from the hardstops, the robot may bump against the hardstops before it is stopped by the software. [Table 1-2 on page 16](#) shows the softstop locations for Joint 1.

1. Load and execute the SPEC.V2 program. Type the following at the prompt:

```
LOAD D:\UTIL\SPEC
```

```
EXE 1 a.spec
```

The main screen appears, as shown in [Figure 1-12](#).

2. Select option 3 => Edit robot specifications.

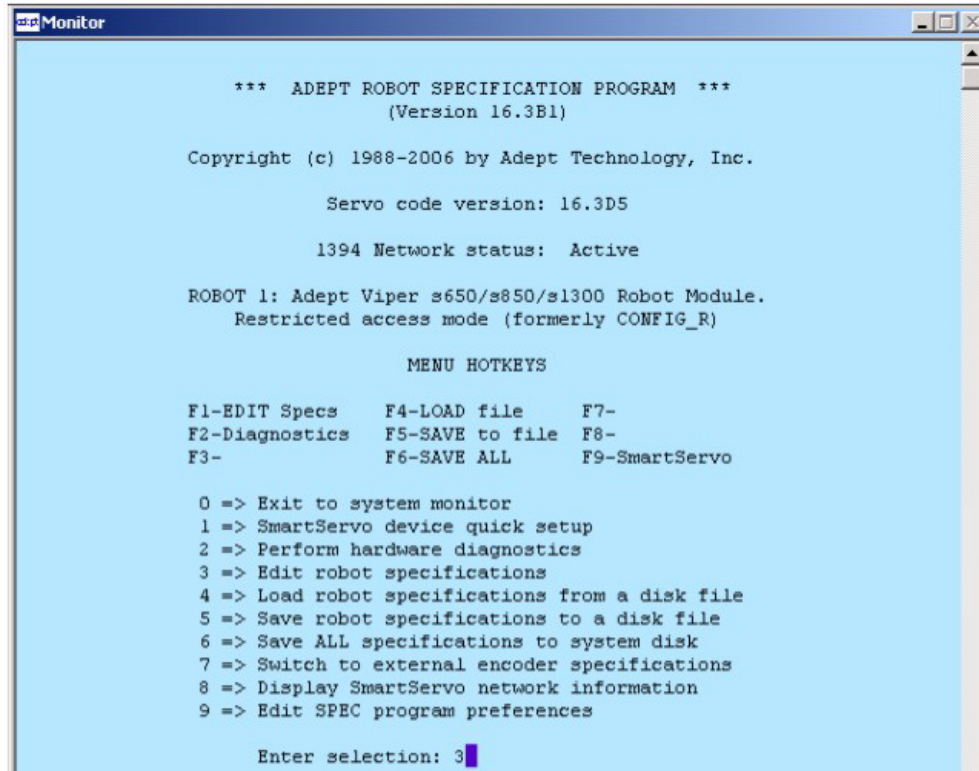


Figure 1-12. SPEC Program Main Menu

3. In the next menu, select option 2 => Edit joint motion specs. See [Figure 1-13](#).

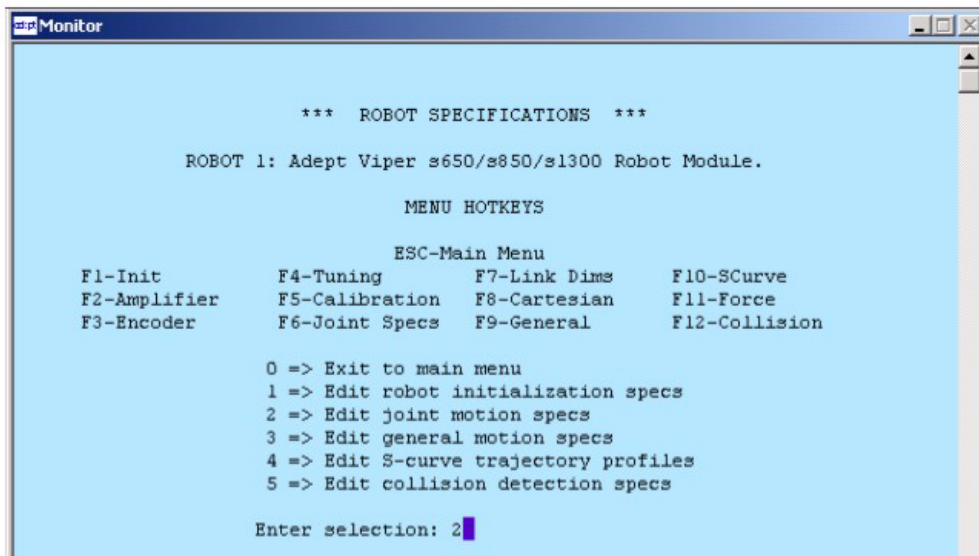


Figure 1-13. Robot Specs Menu

4. The system should go to the menu for Joint 1 - verify this at the top of the screen as shown in [Figure 1-14](#). If it is not displaying Joint 1, select option 1 => Change joint number, and enter 1.

5. After confirming you are in the Joint 1 menu, select option 4 => Lower joint limit. See [Figure 1-14](#).

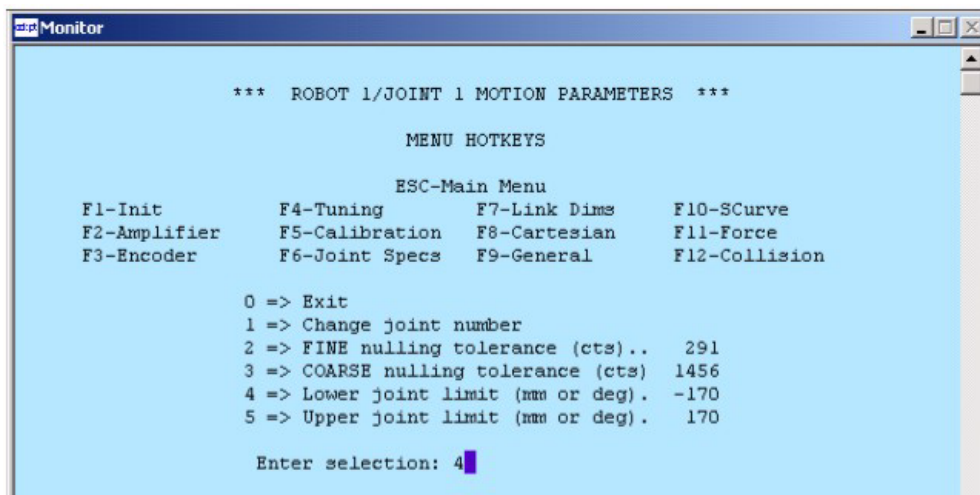


Figure 1-14. Joint 1 Motion Parameters Menu

6. In the next menu, enter the new value for the Joint 1 lower limit softstop. See [Table 1-2](#) for the recommended softstop values. Note that this value must be a negative number.

Table 1-2. Joint 1 Softstops

	Positive-Direction Hardstop				Negative-Direction Hardstop			
	A	B	A'	B'	A	B	A'	B'
Positive-Direction Softstop	0	90	-33.75	-123.75				
Negative-Direction Softstop					33.75	123.75	0	-90

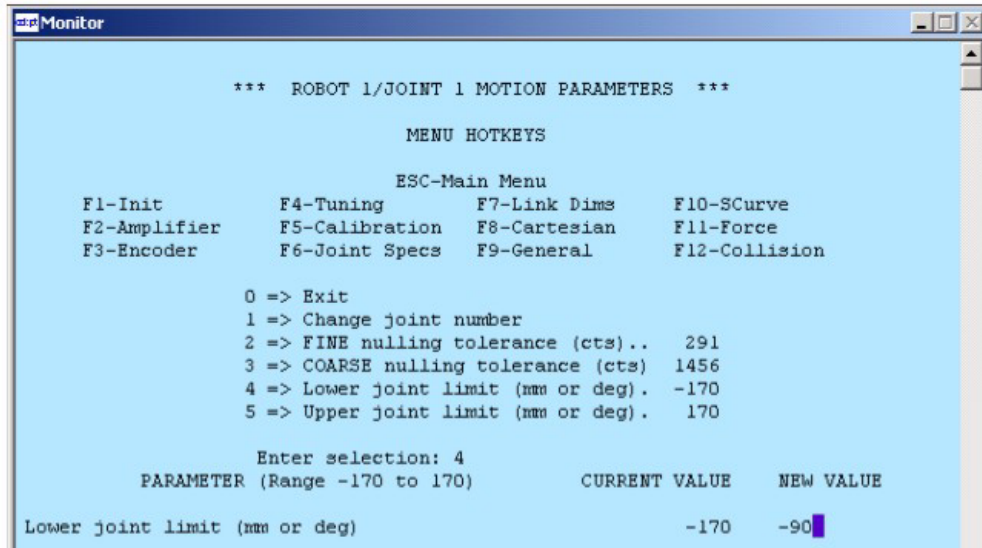


Figure 1-15. Joint 1 Menu - Lower Limits

7. Select option 5=> Upper joint limit. See [Figure 1-16](#).
8. In the next menu, enter the new value for the Joint 1 upper limit softstop. See [Table 1-2](#) for the recommended softstop values.

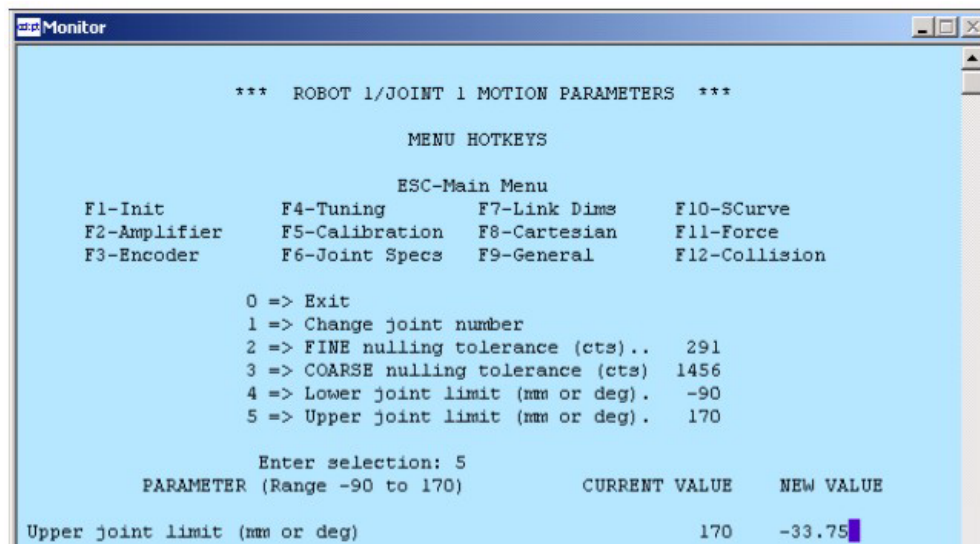


Figure 1-16. Joint 1 Menu - Upper Limits

9. Once you have modified the upper and lower joint limit softstops, you must save the new values. Select option 0 => Exit, then select option 6 = Save ALL specifications to system disk.
10. Reboot the system by cycling 24 VDC power to the SmartController and cycling the power switch on the PA4. The new joint limits will be used after the system reboots.

11. Use the pendant to verify that the robot's range of motion is restricted to the specified softstop locations. If the robot's range of motion does not conform to the specified positions, repeat this procedure.

2

At the time of delivery from the factory, mechanical ends (hardstops) are set inside the Adept Viper s650 and s850 robots such that the workable angles of the Joint 2 and Joint 3 axes are the angles shown in [Table 2-1](#).

Working Angle for Joint 2	Working Angle for Joint 3
-140°, -22.5°	+75.5°, +218°

The parts for the Joint 2 hardstops are the same for both the s650 and s850 robots. The parts for the Joint 3 hardstops are different for the s650 and s850 robots.

NOTE: The limits to the workable angles of the robot are defined by the software motion limit (softstops). The softstops need to be set inside the hardstop positions (see “[Modifying Joint Limit Softstop Locations for Joint 2](#)” on page 21 and “[Modifying Joint Limit Softstop Locations for Joint 3](#)” on page 30).

2.2 Joint 2 Adjustable Hardstops

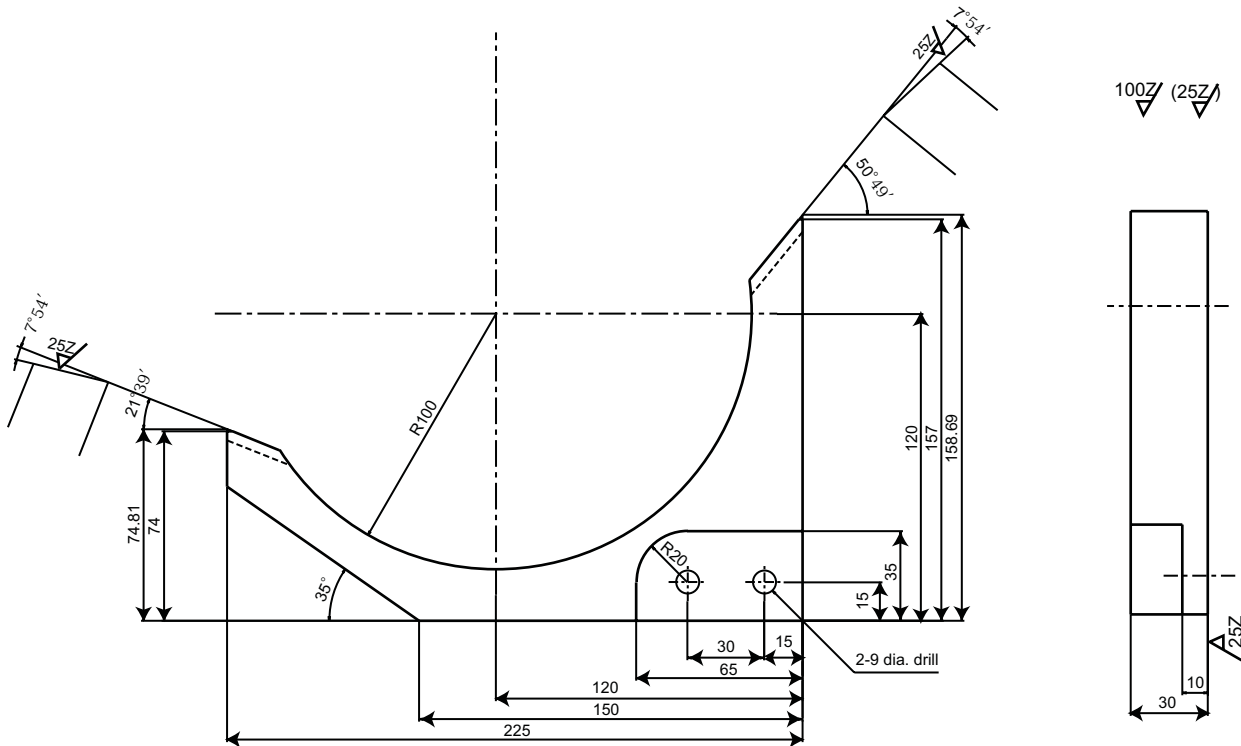
To add hardstops to Joint 2, perform the following steps:

- Make the hardstop parts. See [“Making the Hardstop Parts for Joint 2” on page 20.](#)
- Install the hardstop parts on the outside of the Adept Viper s650 or s850 robot. See [“Joint 2 Installation Procedure” on page 21.](#)
- Modify the joint limit softstop locations for Joint 2 using the SPEC program. See [“Modifying Joint Limit Softstop Locations for Joint 2” on page 21.](#)

Making the Hardstop Parts for Joint 2

Use the drawing below to make the following hardstop part. The material to use for the part is identified in the drawing.

- Curved plate, quantity 1 (see [Figure 2-1](#))



Material: 6061 T6 Aluminum

Figure 2-1. Joint 2 Plate for s650/s850 Robots

Joint 2 Installation Procedure

The Joint 2 hardstop consists of one curved plate that is the adjustable hardstop, and the required screws to install them. (These are all user-provided parts.)

1. Secure the plate to the two threaded holes on the arm-side of the robot using two M8 x 25 bolts. Tighten to a torque of $19.6 \text{ Nm} \pm 20\%$.

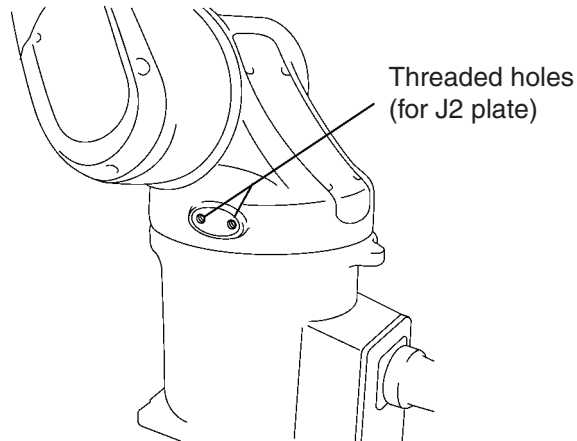


Figure 2-2. Threaded Holes for Joint 2 Plate

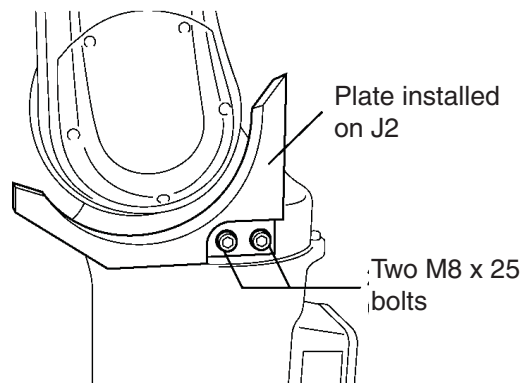


Figure 2-3. Plate Installed on Joint 2

Modifying Joint Limit Softstop Locations for Joint 2

After installing the hardstop, you must modify the softstop locations using the SPEC program.

1. Load and execute the SPEC.V2 program. Type the following at the prompt:

```
LOAD D:\UTIL\SPEC
```

```
EXE 1 a.spec
```

The main screen appears as shown in [Figure 1-12 on page 15](#).

2. Select option 3 => Edit robot specifications.

3. In the next menu, select option 2 => Edit joint motion specs. See [Figure 1-13 on page 15](#).
4. In the next menu, select option 1 => Change joint number, and enter 2. Verify this at the top of the screen, as shown in [Figure 2-4](#).

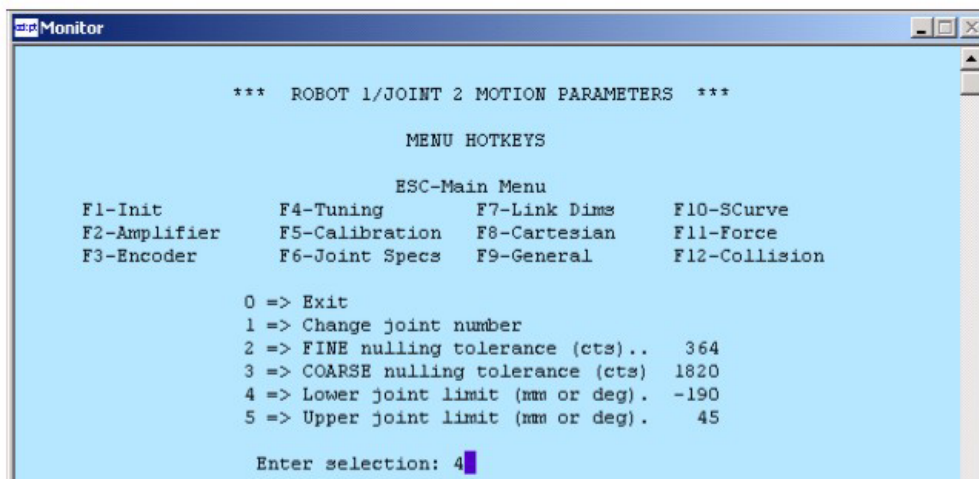


Figure 2-4. Joint 2 Motion Parameters Menu

5. After confirming you are in the Joint 2 menu, select option 4 => Lower joint limit.
6. In the next menu (see [Figure 2-5](#)), enter the new value for the Joint 2 lower limit softstop. See [Table 2-2](#) for recommended softstop values. Note that this value must be a negative number.

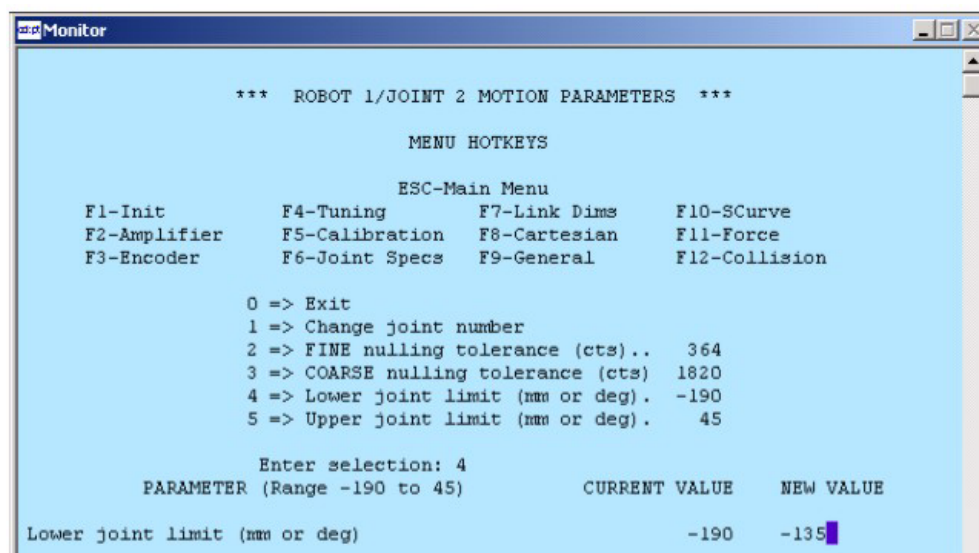


Figure 2-5. Joint 2 Menu - Lower Limits

Table 2-2. Joint 2 Ranges for Adjustable Hardstops

	Hardstop Value	Recommended Joint Limit Softstop Values
J2 Hardstop	- 140° to - 22.5°	Lower limit: - 135° Upper limit: - 27.5°

7. Select option 5=> Upper joint limit. See [Figure 2-6](#).
8. In the next menu, enter the new value for the Joint 2 upper limit softstop. See [Table 2-2](#) for the recommended softstop values.

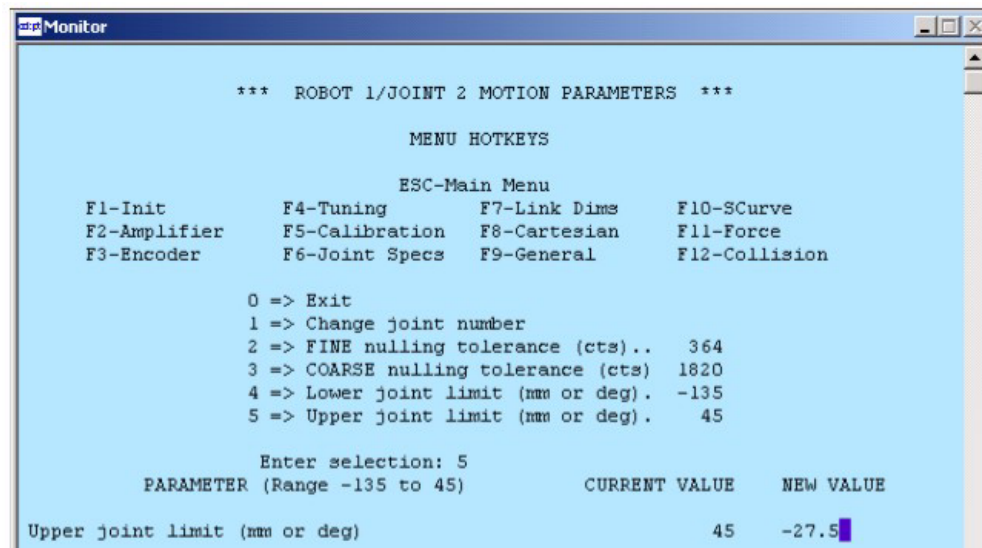


Figure 2-6. Joint 2 Menu - Upper Limits

9. Once you have modified the upper and lower joint limit softstops, you must save the new values. Select option 0 => Exit, then select option 6 = Save ALL specifications to system disk.
10. Reboot the system by cycling 24 VDC power to the SmartController and cycling the power switch on the PA4. The new joint limits will be used after the system reboots.
11. Use the pendant to verify that the robot's range of motion is restricted to the specified softstop locations. If the robot's range of motion does not conform to the specified positions, repeat this procedure.

2.3 Joint 3 Adjustable Hardstops

To add hardstops to Joint 3, perform the following steps:

- Make the hardstop parts. See [“Making the Hardstop Parts for Joint 3” on page 24.](#)
- Install the hardstop parts on the outside of the Adept Viper s650 or s850 robot. To install hardstops on Joint 3, see [“Joint 3 Installation Procedure” on page 28.](#)
- Modify the joint limit softstop locations for Joint 3 using the SPEC program. See [“Modifying Joint Limit Softstop Locations for Joint 3” on page 30.](#)

Making the Hardstop Parts for Joint 3

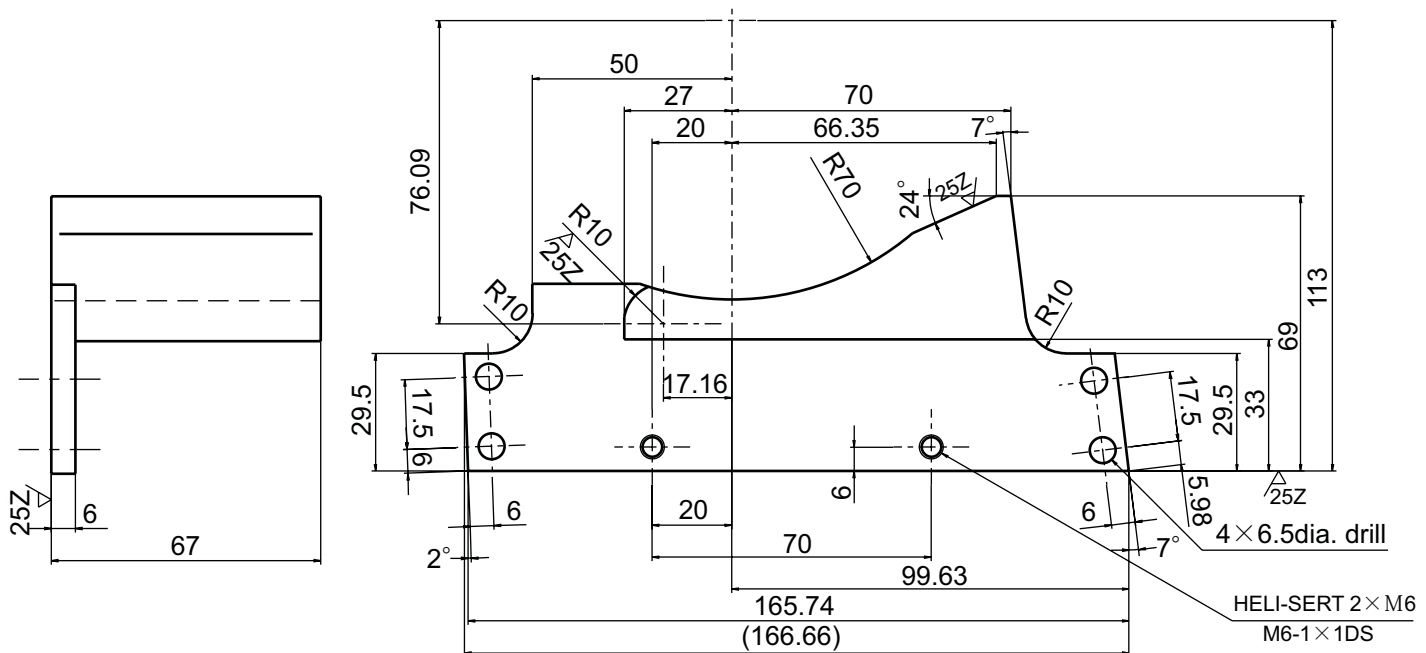
Use the drawings below to make the following hardstop parts. The materials to use for the parts are identified in the drawings.

NOTE: The parts for the Joint 3 hardstops are different for the Viper s650 and s850 robots.

Viper s650 Hardtop Parts

To add a hardstop to a Viper s650, make the parts listed below.

- Curved plate, quantity 1 (see [Figure 2-7](#))
- Stay, quantity 1 (see [Figure 2-8](#))
- Spacer, quantity 2 (see [Figure 2-9](#))



Material: 6061 T6 Aluminum

Figure 2-7. Joint 3 Plate for s650 Robot

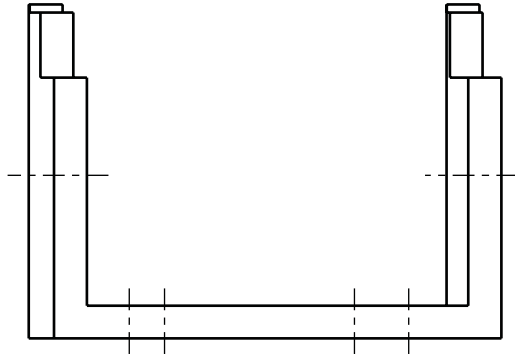
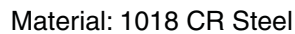
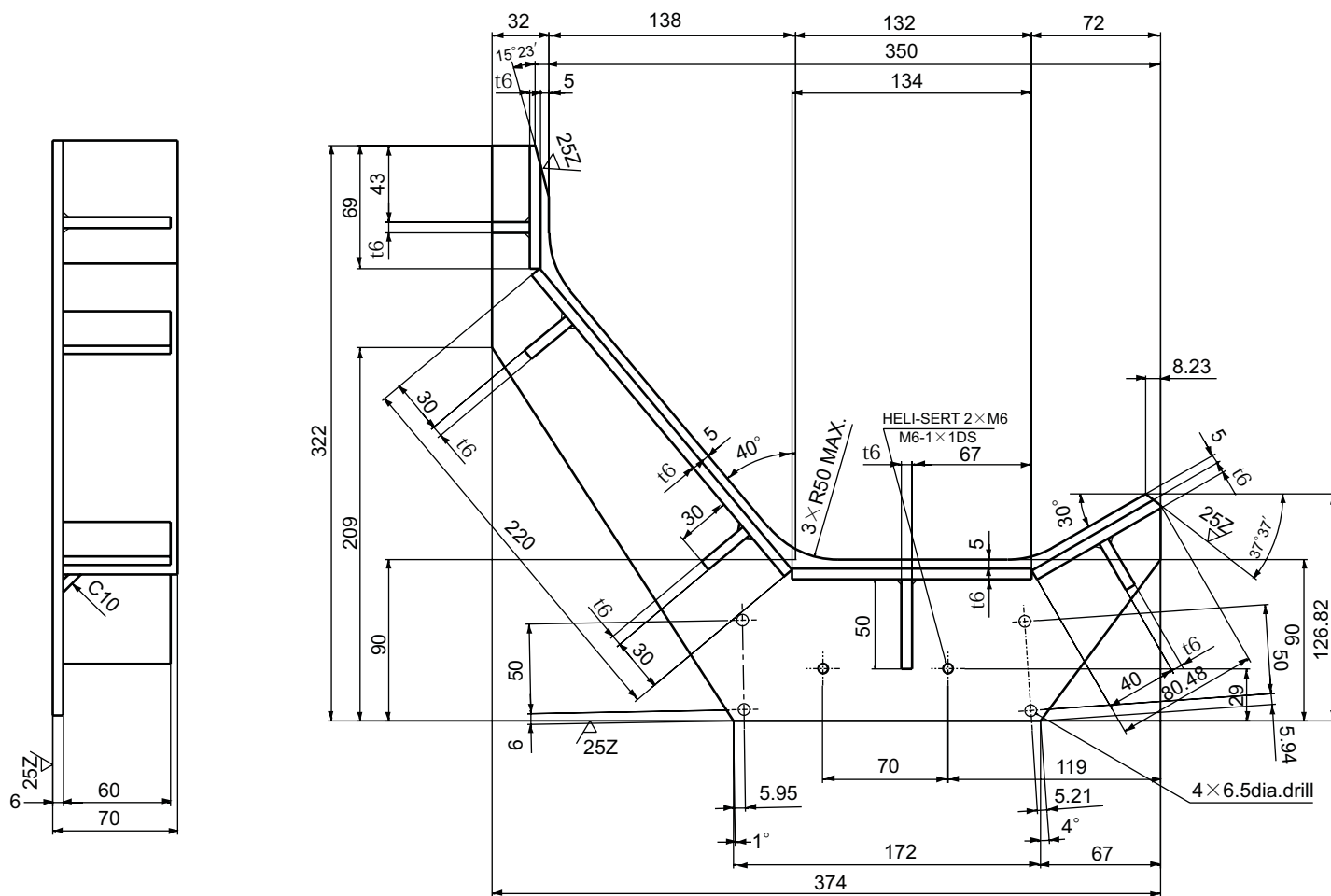


Figure 2-8. Joint 3 Stay for s650 Robot



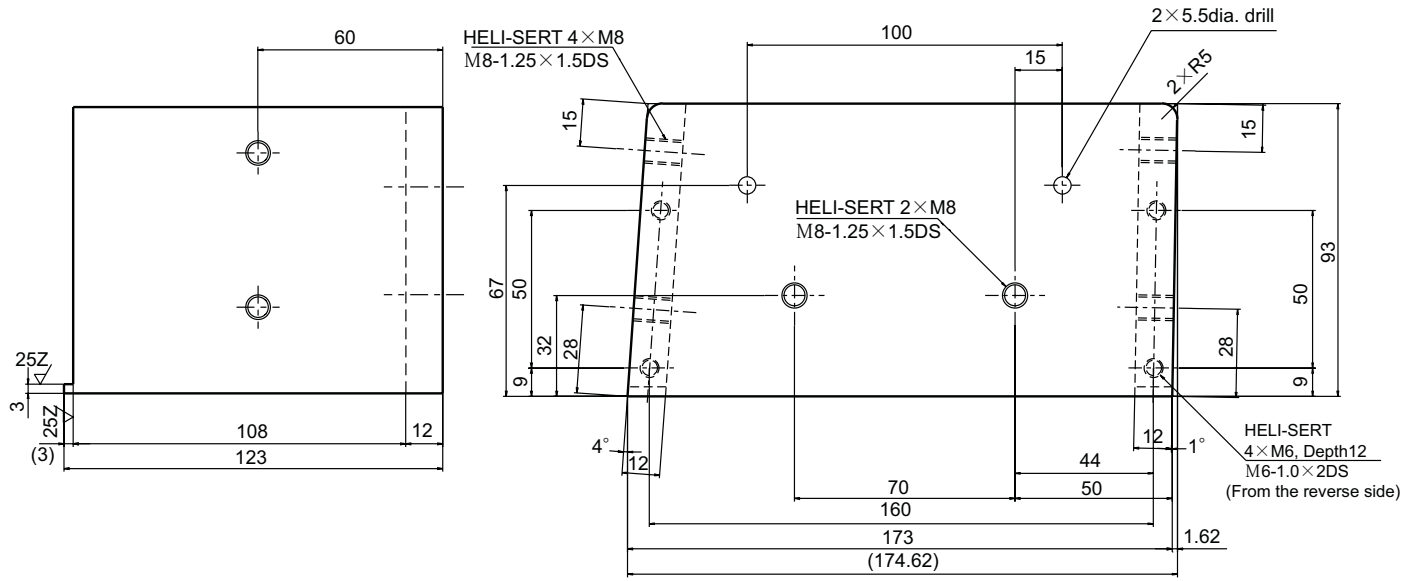
Viper s850 Hardtop Parts

- Curved plate, quantity 1 (see [Figure 2-10](#))
- Stay, quantity 1 (see [Figure 2-11](#))
- Spacer, quantity 2 (see [Figure 2-12](#))



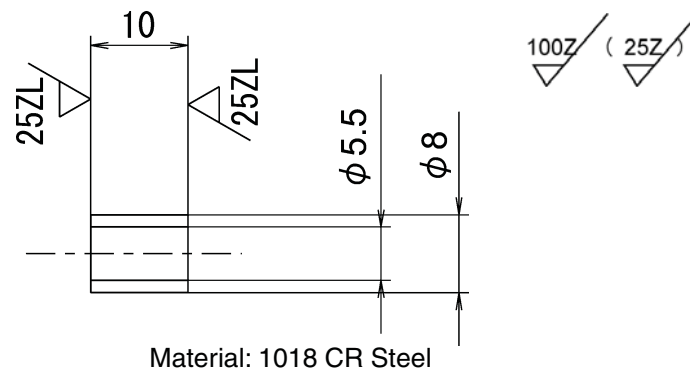
Material: 6061 T6 Aluminum

Figure 2-10. Joint 3 Plate for s850 Robot



Material: 6061 T6 Aluminum

Figure 2-11. Joint 3 Stay for s850 Robot



Material: 1018 CR Steel

Figure 2-12. Joint 3 Spacer for s850 Robot

Joint 3 Installation Procedure

Refer to the drawings below for information on installing hardstops on Joint 3 of Viper s650 or s850 robots. Both robots require a user-provided plate, stay, and spacers; however, the parts are different for the s650 and s850 robots (see [“Making the Hardstop Parts for Joint 3” on page 24](#)).

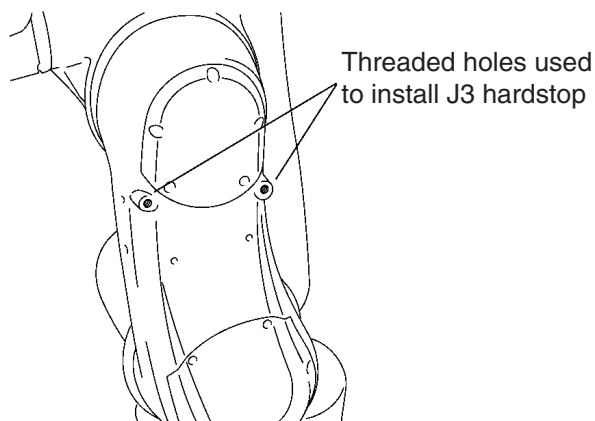


Figure 2-13. Threaded Holes for Joint 3 Hardstop

Viper s650 Joint 3 Installation Procedure

Refer to the drawings below to complete the Joint 3 hardstop installation on a Viper s650 robot.

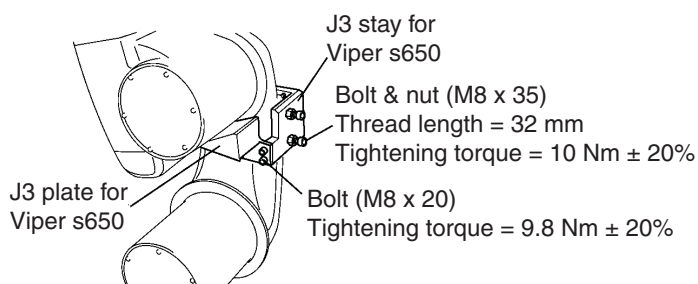


Figure 2-14. Joint 3 Hardstop Installation on Viper s650 (1)

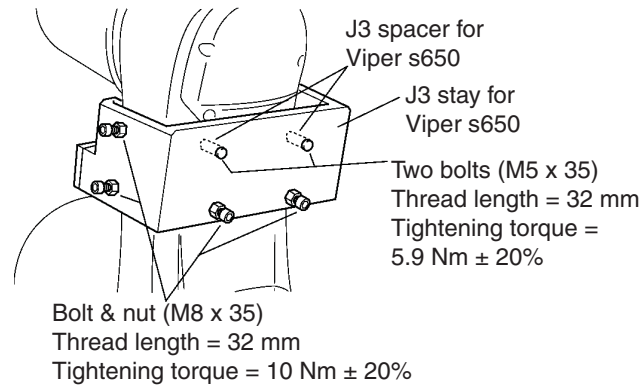


Figure 2-15. Joint 3 Hardstop Installation on Viper s650 (2)

Viper s850 Joint 3 Installation Procedure

Refer to the drawings below to complete the Joint 3 hardstop installation on a Viper s850 robot.

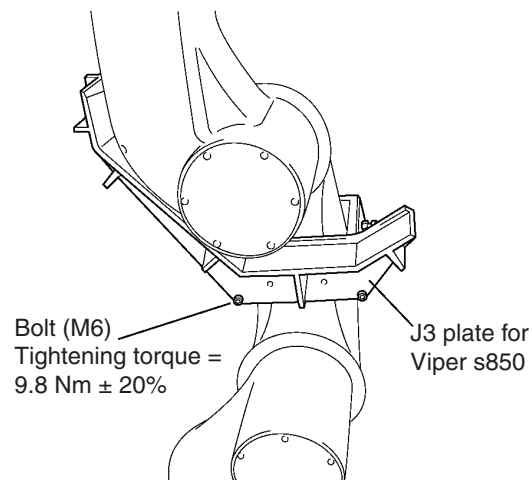


Figure 2-16. Joint 3 Hardstop Installation on Viper s850 (1)

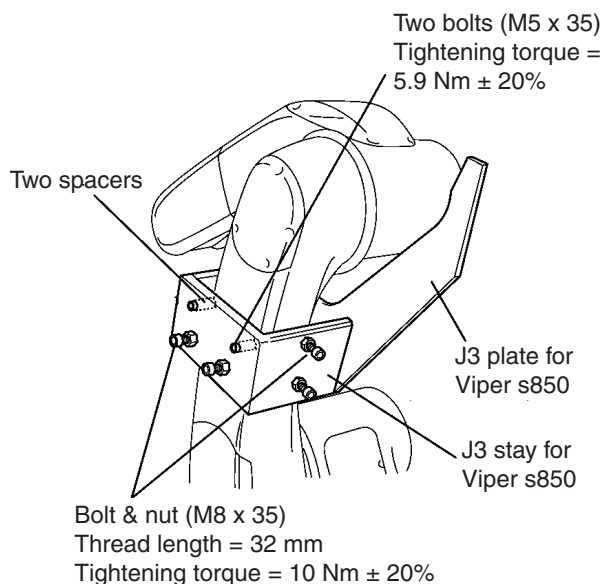


Figure 2-17. Joint 3 Hardstop Installation on Viper s850 (2)

Modifying Joint Limit Softstop Locations for Joint 3

After installing the hardstop, you must modify the softstop locations using the SPEC program.

1. Load and execute the SPEC.V2 program. Type the following at the prompt:

LOAD D:\UTIL\SPEC

EXE 1 a.spec

The main screen appears as shown in [Figure 1-12 on page 15](#).

2. Select option 3 => Edit robot specifications.
3. In the next menu, select option 2 => Edit joint motion specs. See [Figure 1-13 on page 15](#).
4. In the next menu, select option 1 => Change joint number, and enter 3. Verify that Joint 3 is selected by checking the top of the screen that is displayed.
5. After confirming you are in the Joint 3 menu, select option 4 => Lower joint limit.
6. In the next menu, enter the new value for the Joint 3 lower limit softstop. See [Table 2-3](#) for recommended softstop values.

Table 2-3. Joint 3 Ranges for Adjustable Hardstops

	Hardstop Value	Recommended Joint Limit Softstop Values
J3 Hardstop	+75.5° to +218°	Lower limit: +80.5° Upper limit: +213°

7. Select option 5=> Upper joint limit.

8. In the next menu, enter the new value for the Joint 3 upper limit softstop.
9. Once you have modified the upper and lower joint limit softstops, you must save the new values. Select option 0 => Exit, then select option 6 = Save ALL specifications to system disk.
10. Reboot the system by cycling 24 VDC power to the SmartController and cycling the power switch on the PA4. The new joint limits will be used after the system reboots.
11. Use the pendant to verify that the robot's range of motion is restricted to the specified softstop locations. If the robot's range of motion does not conform to the specified positions, repeat this procedure.

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